Evaluation of AIRS Ozone

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Questions?

- When and where does AIRS have skills?
- To what extent can AIRS provide tropospheric ozone? Where does the information come from?
- How do we validate our product? Can we use tracer correlations (O3-CO)?
- How can we improve the ozone retrieval?

Related Validation Activities

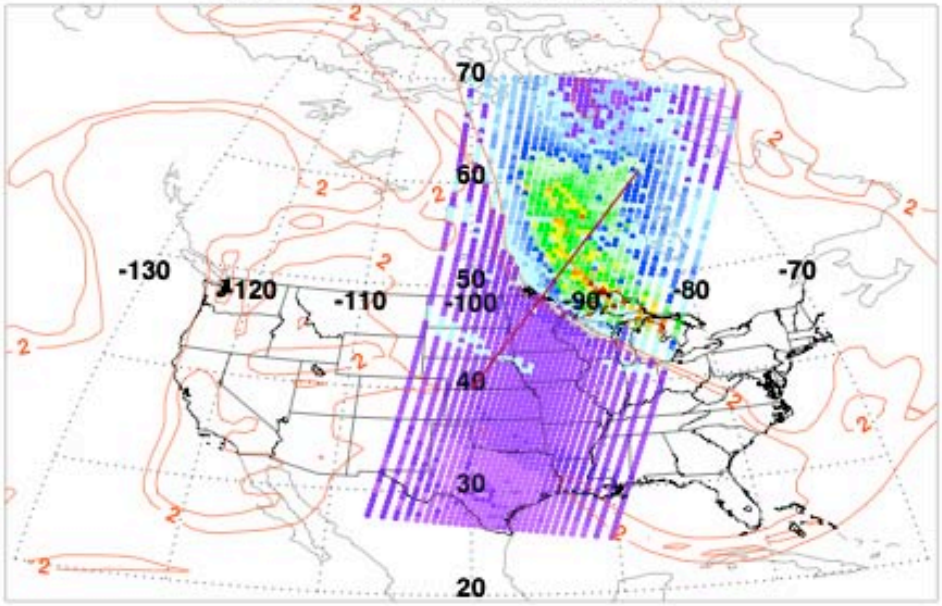
Scales	In Situ	Feature	Collaborator
Global	Global Sondes (WOUDC) (Beijing, Boulder, Lauder)	Global Profile Match-up	Murty Divakarla Laura Pan (NCAR) Kathleen Monahan (UC)
Large (UT/LS)	START	Stratospheric Intrusion	Laura Pan (NCAR)
Regional (mid-trop)	AMMA-AEROSE II	Biomass Burning	Nick Nalli Everette Joseph (HU)
Small (boundary)	WAVES	Air Quality	Dave Whiteman (NASA) Everette Joseph (HU)

Case Study for AIRS Ret. Sensitivity

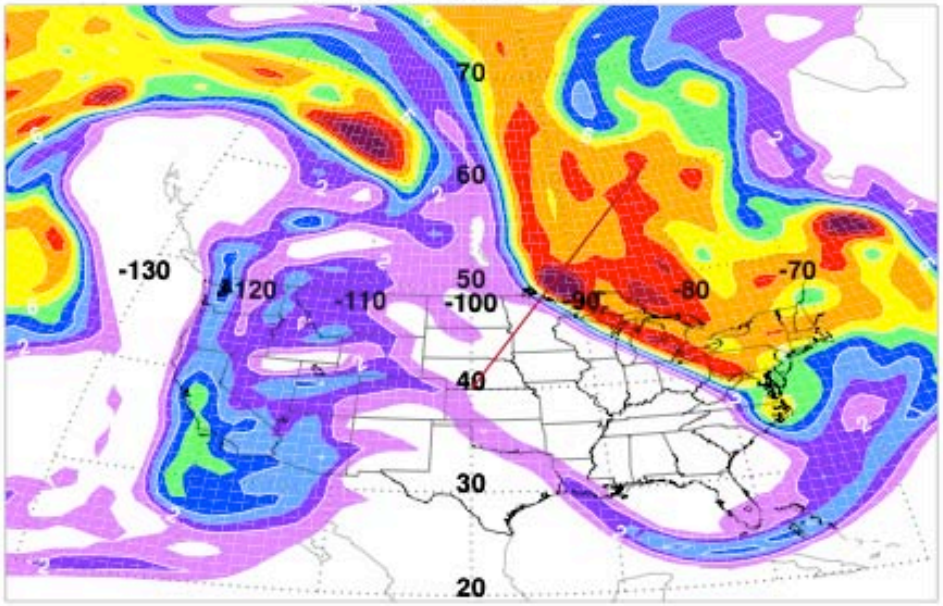
- Typically, retrieval sensitivity is analyzed using a nominal/statistical atmospheric profiles

- The actual instrument sensitivity is profile dependent. The change in thermal structure should change the location of instrument's vertical sensitivity

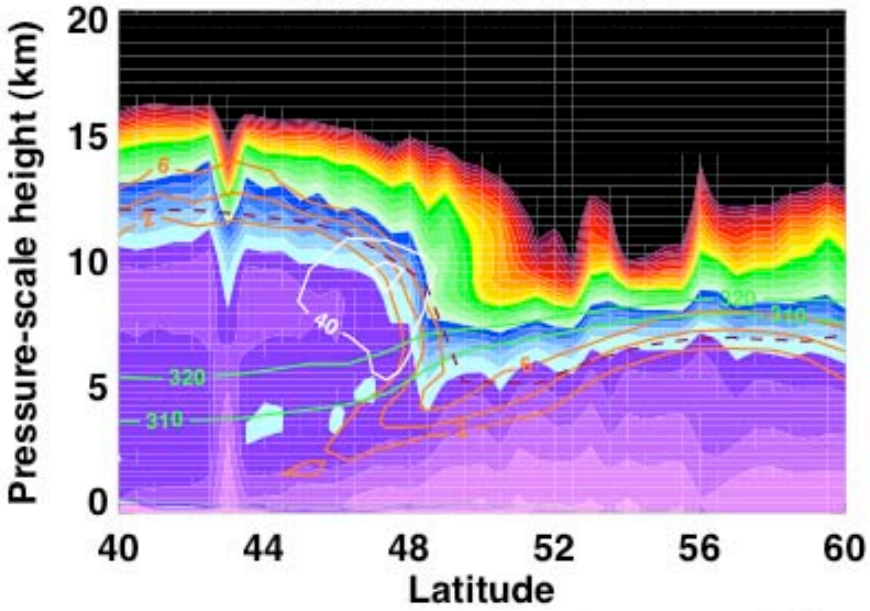
AIRS ozone 300-250 mb 2005-11-24



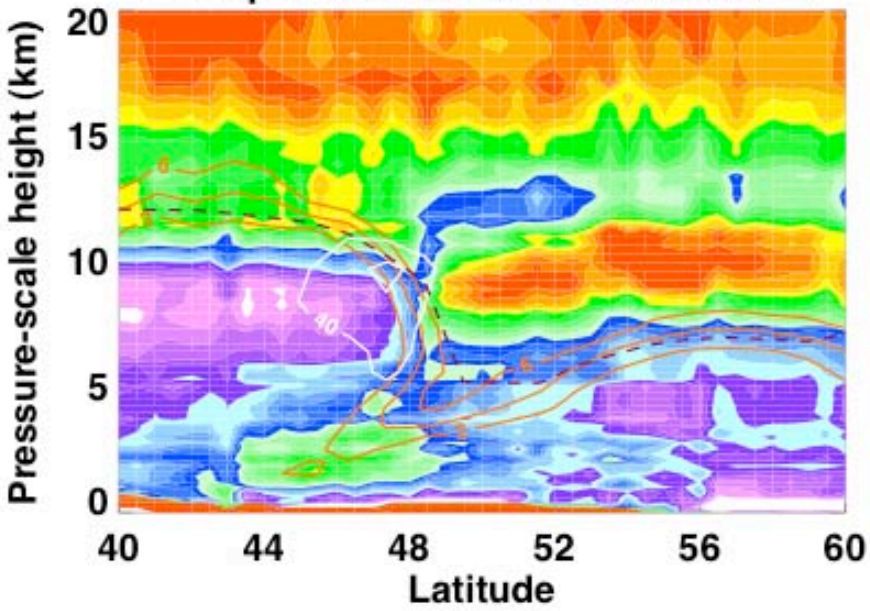
GFS PV 2005-11-24 6Z

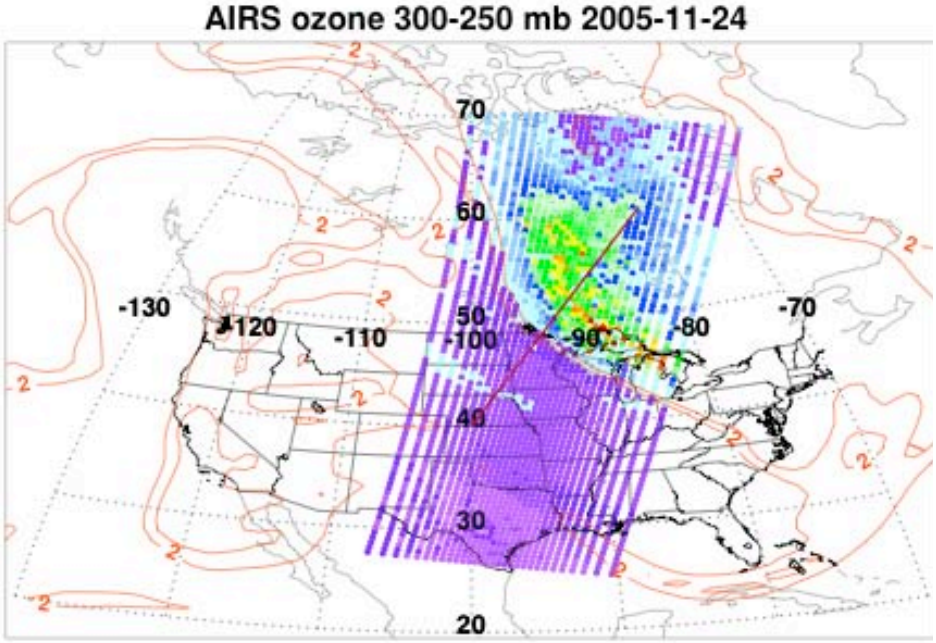


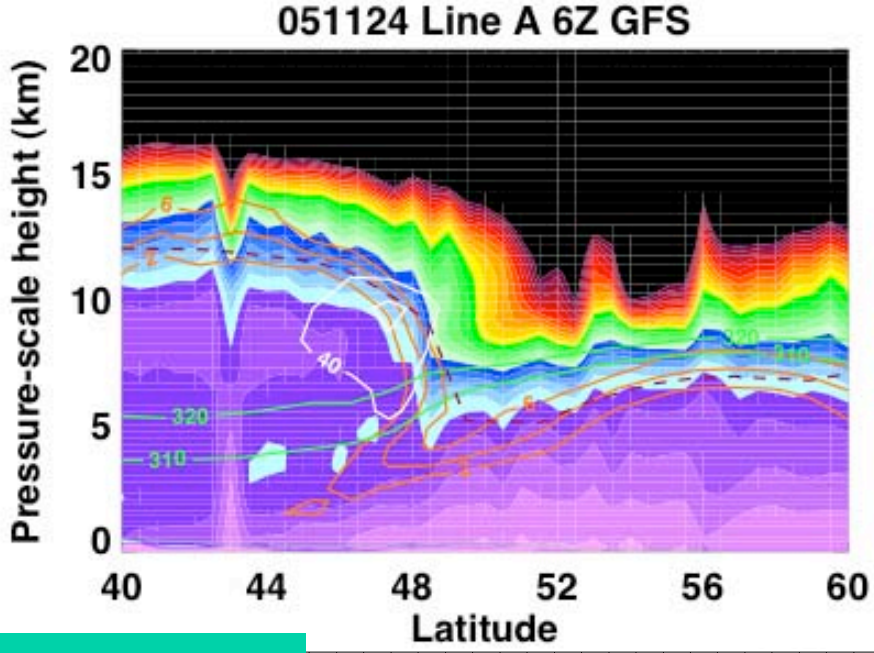
051124 Line A 6Z GFS



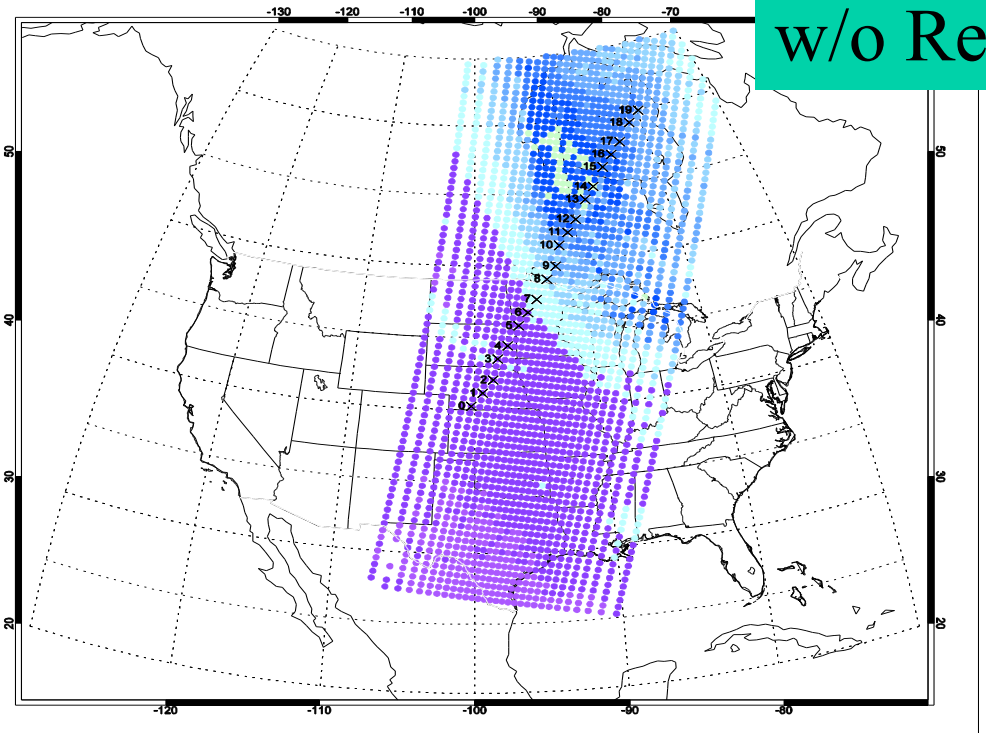
PT Lapse rate 051124 Line A 6Z GFS

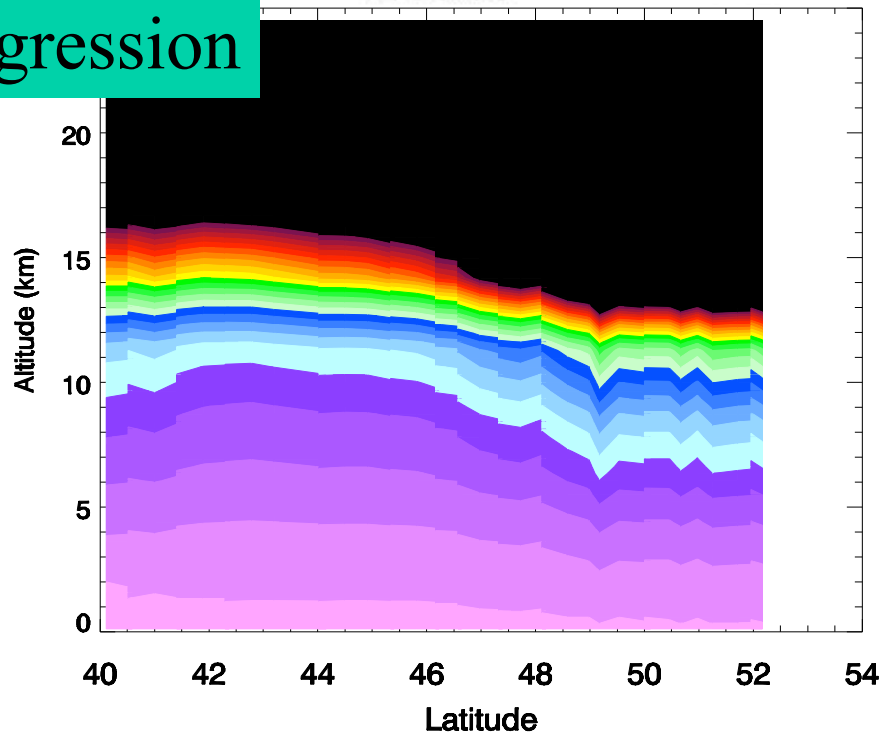




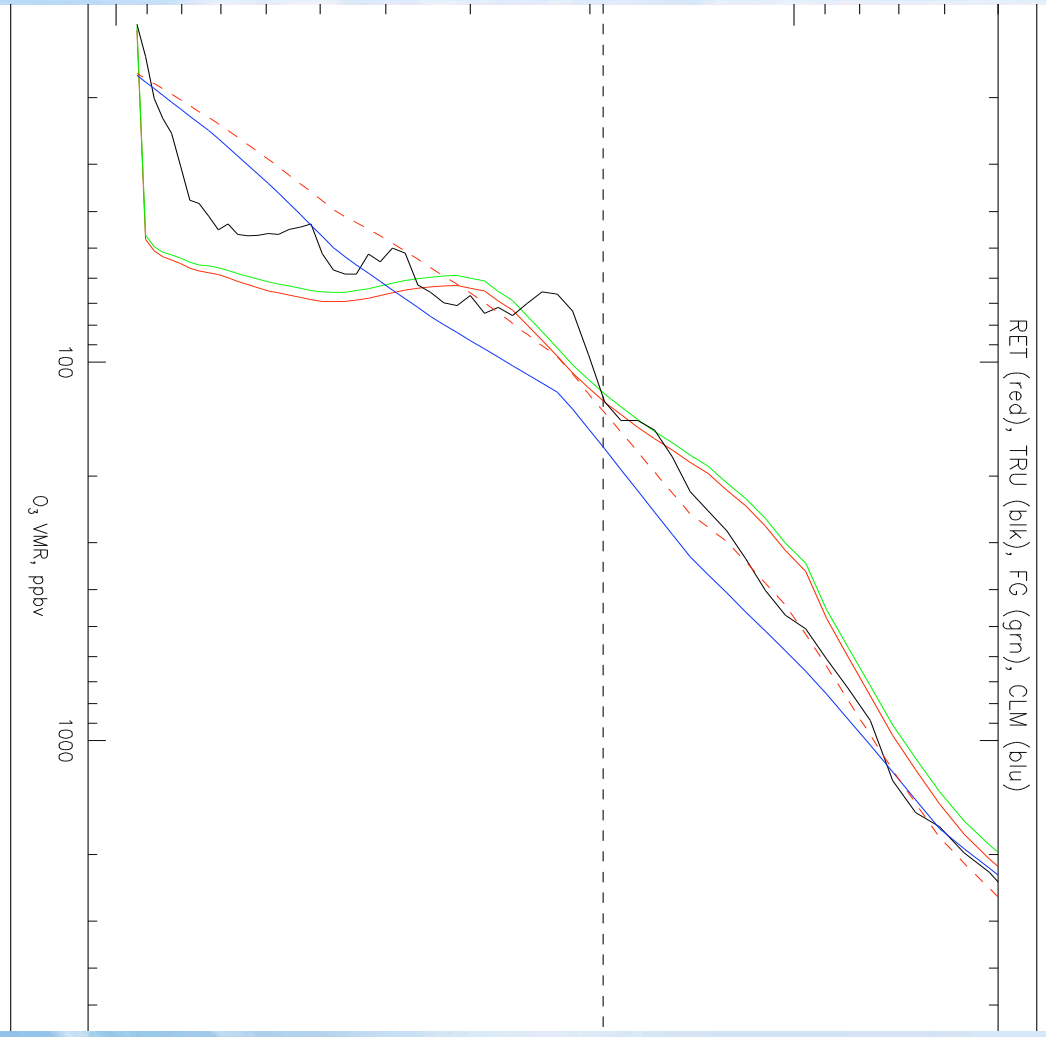


w/o Regression





Typical Ozone Profile
No Stratospheric Intrusion (SI)

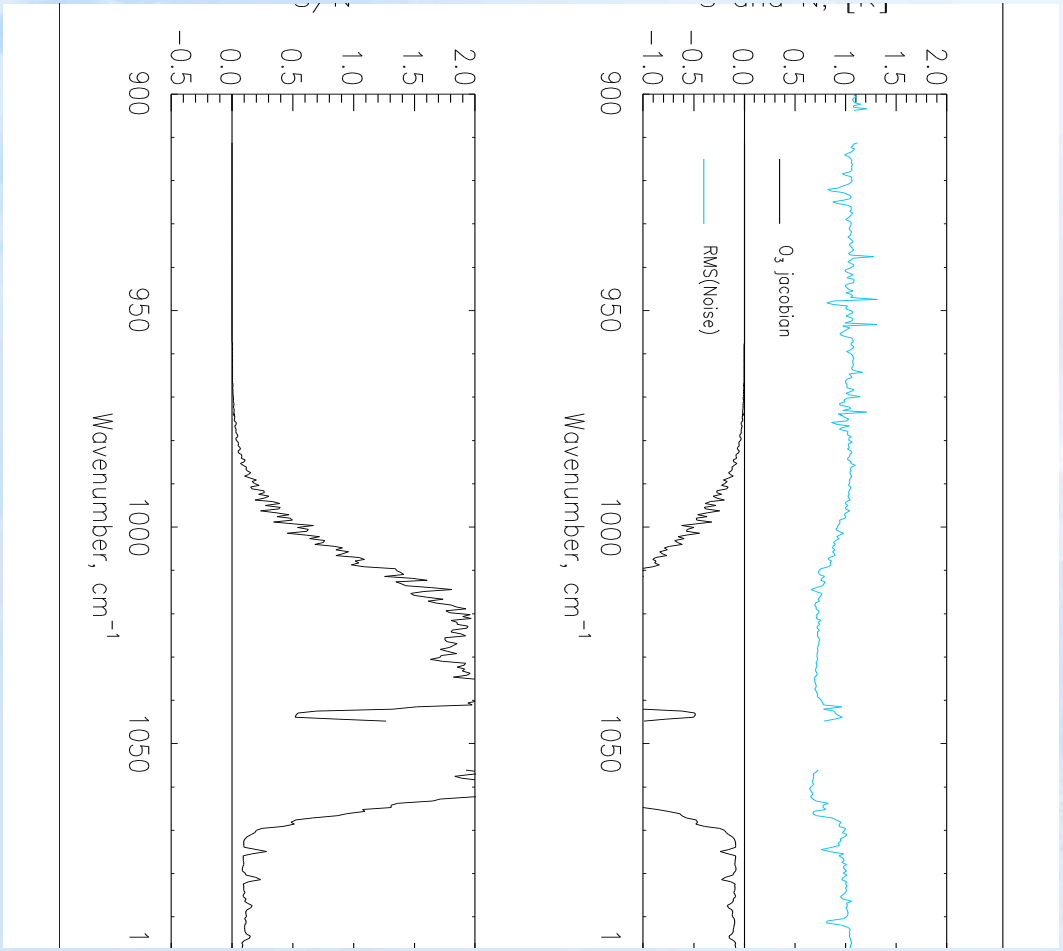


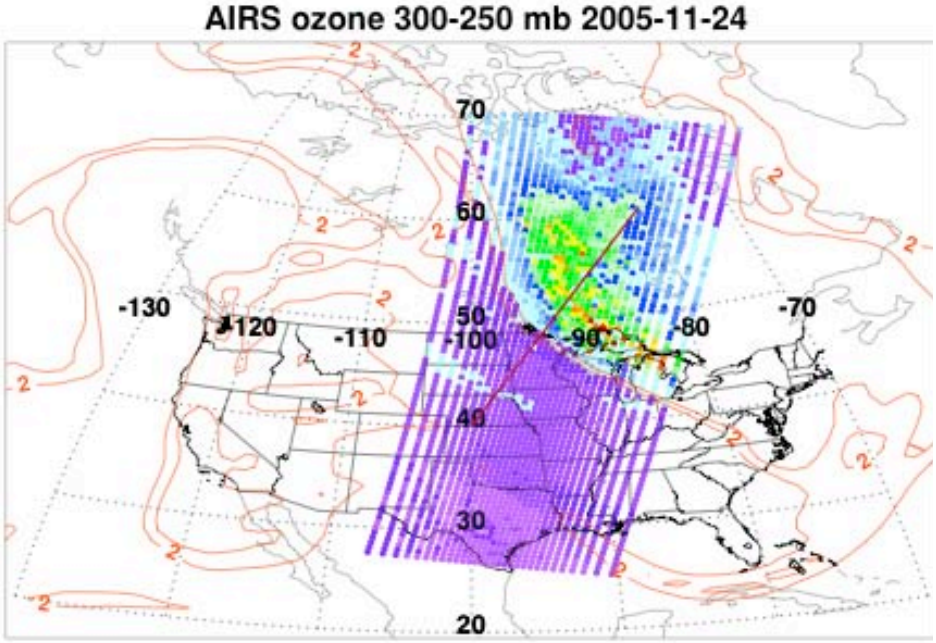
Lauder, New Zealand

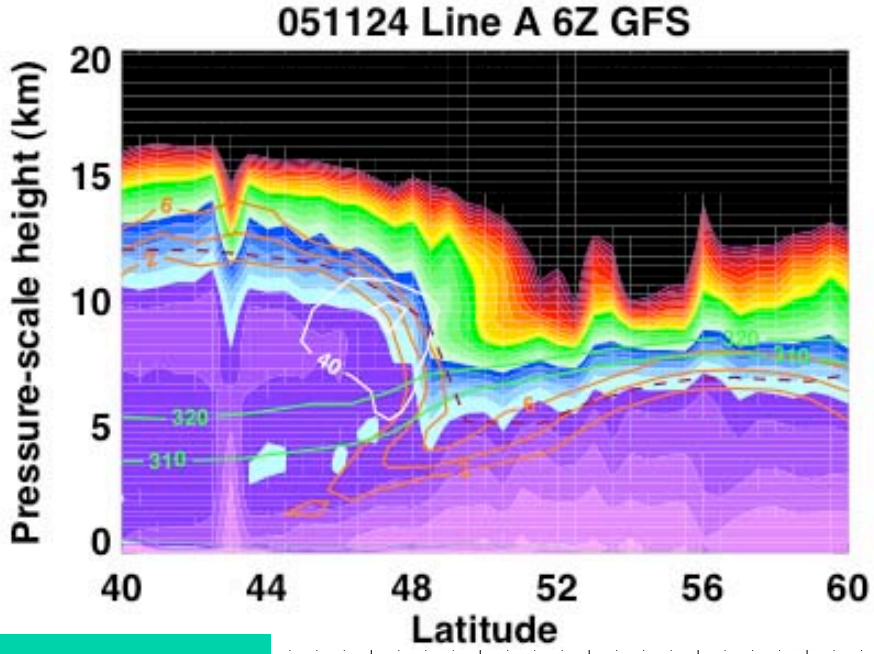
- Retrieval vertical structure (ozone vertical variability) comes from regression
- Ozone is severely damped in physical retrieval
- Ozone channels in physical process are not optimized
- Ozone vertical functions are not optimized

Experiment in Physical Ret.

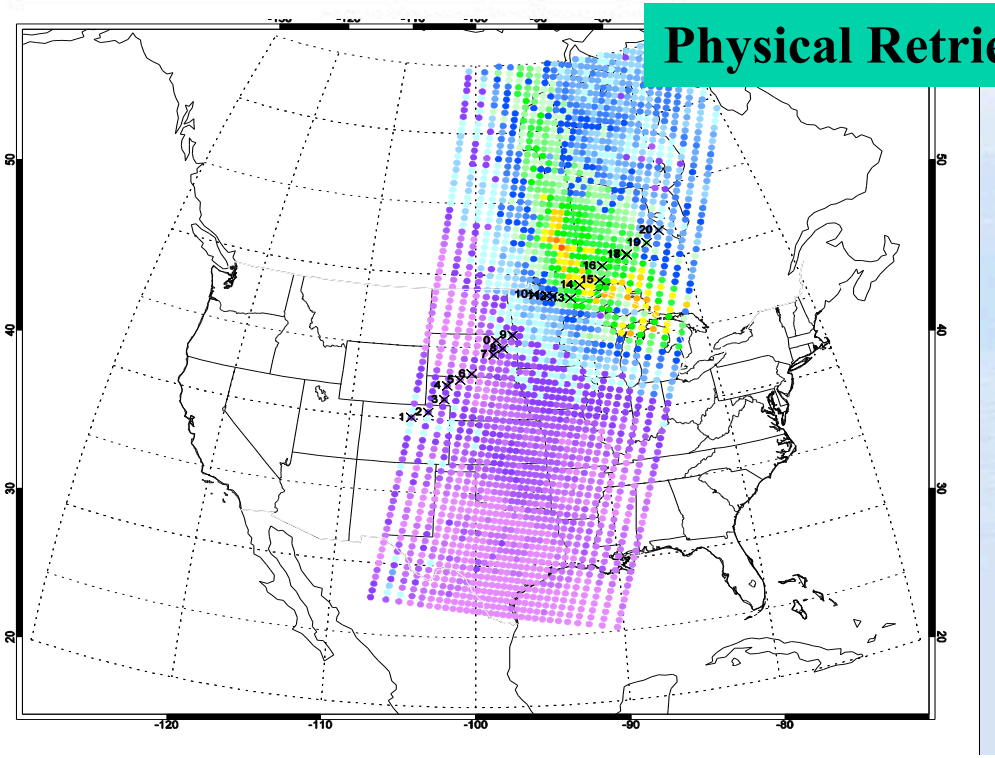
- Channel Selection
- Damping parameter (ogwt)
- Vertical Functions (Trapezoids)

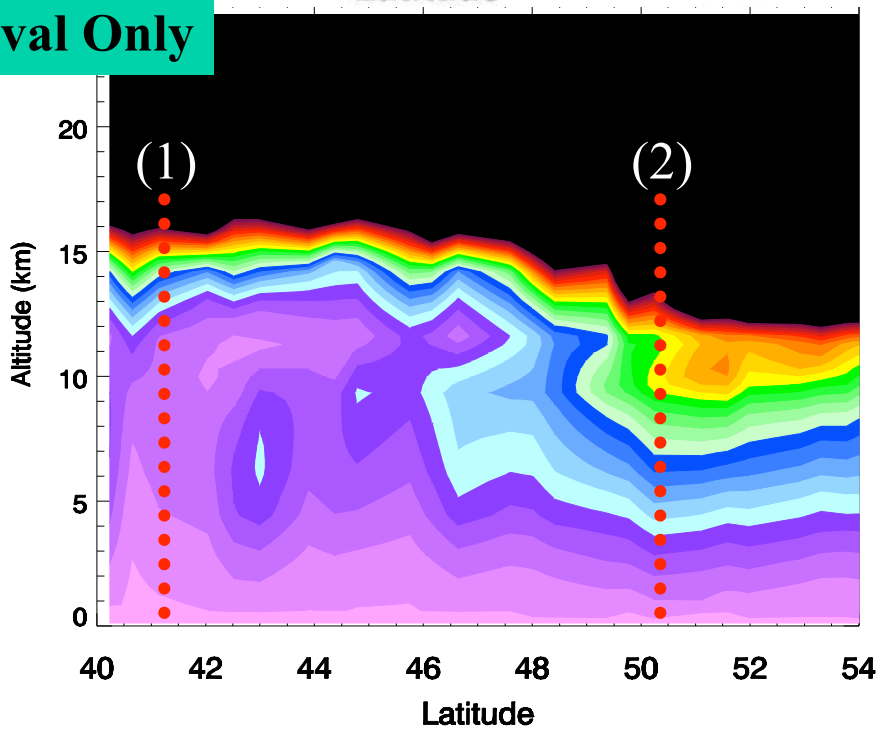




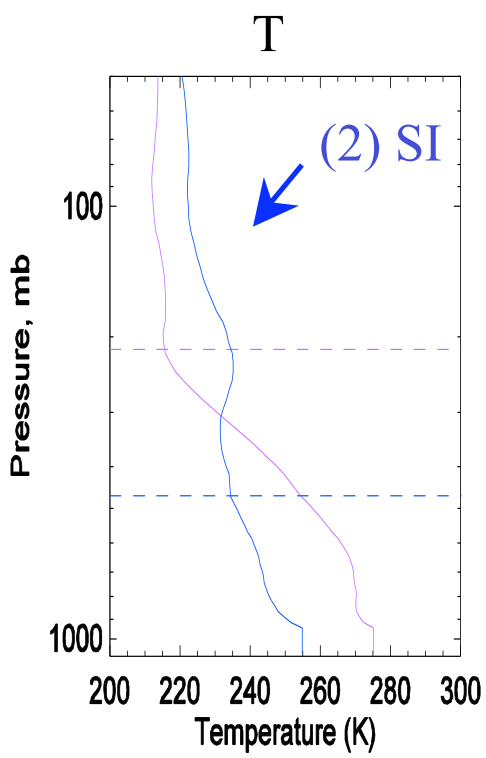


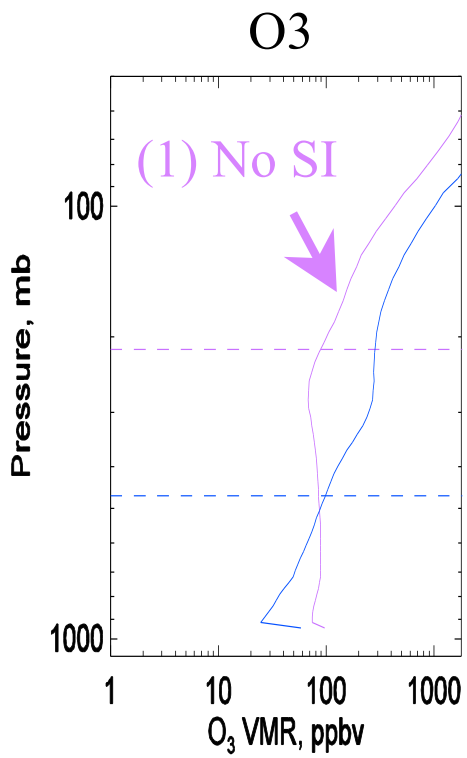
Physical Retrieval Only





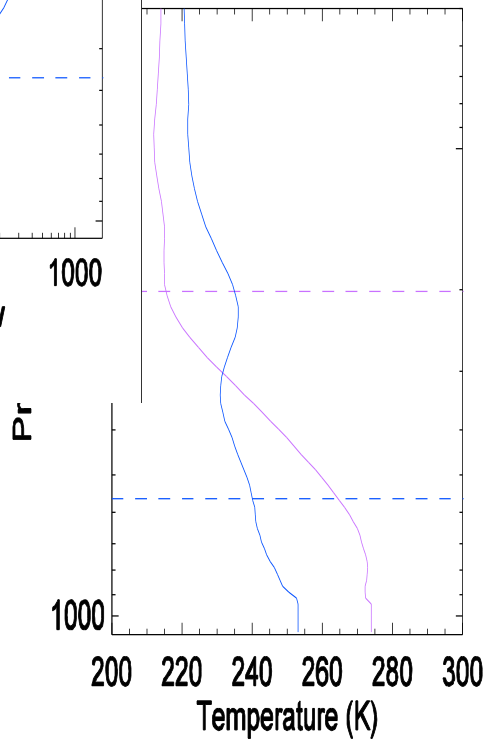
AIRS Ret. w/ Diff Thermal Cond'n

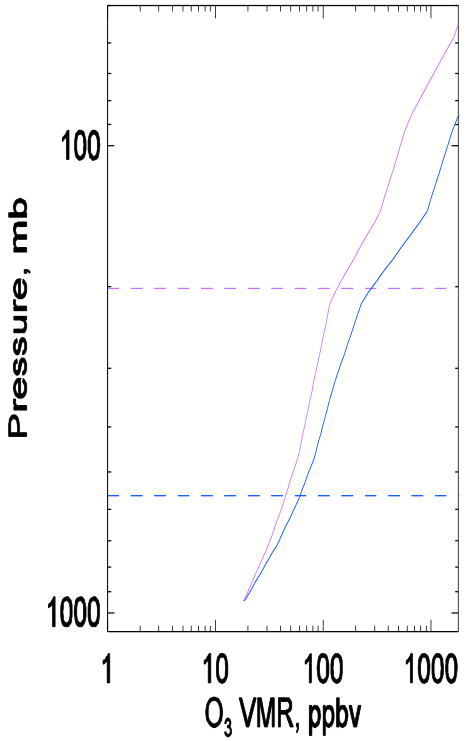




w/ Regression

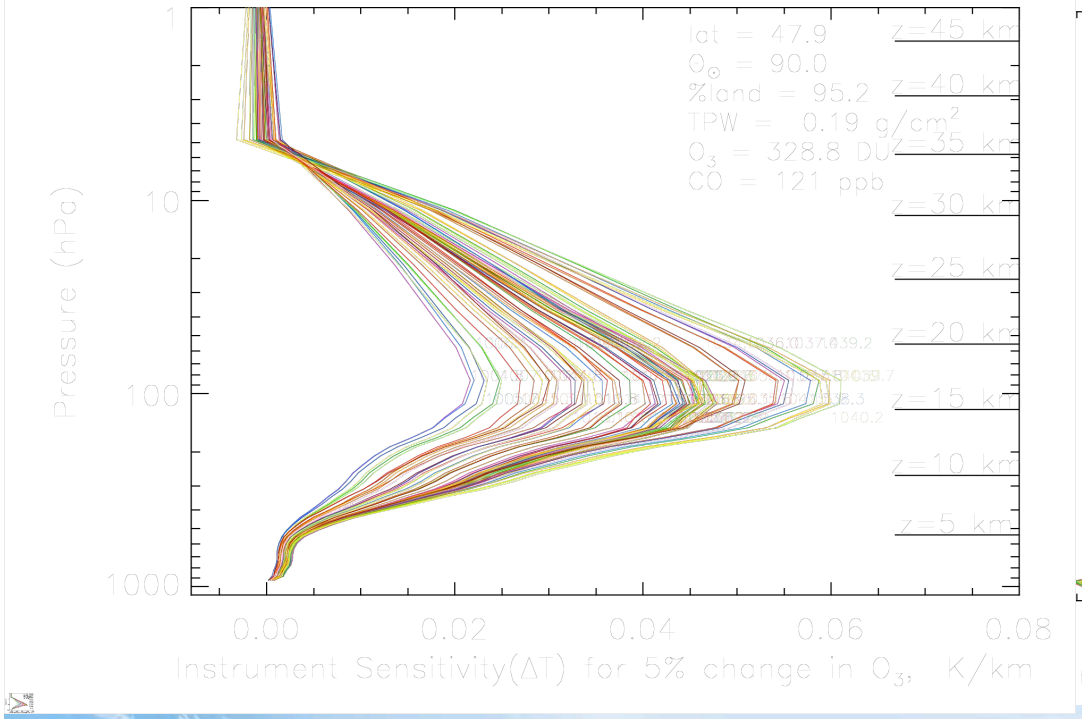
No Regression



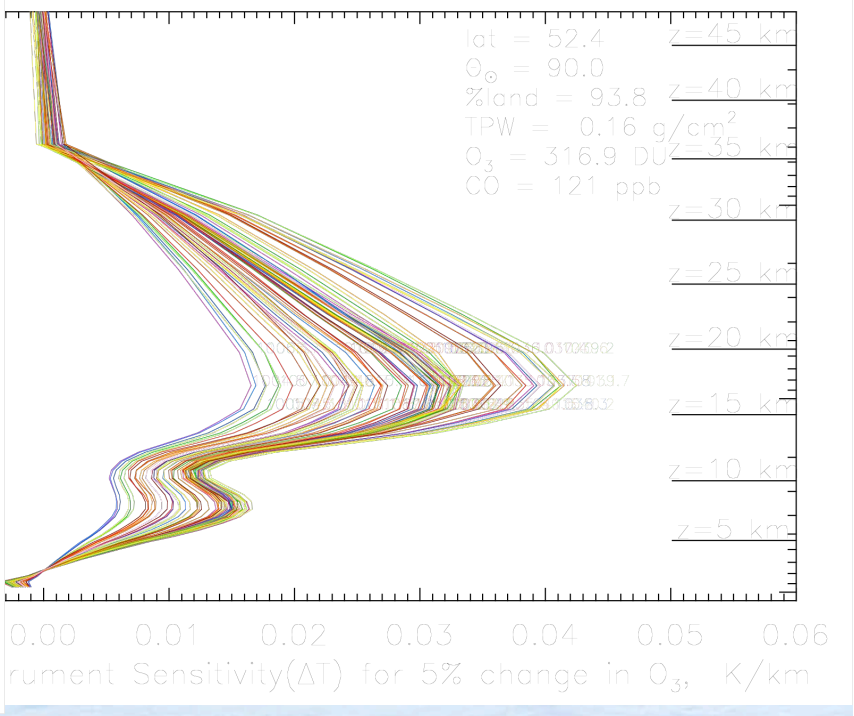


Channel Kernel Functions

(1) No Stratospheric Intrusion



(2) Stratospheric Intrusion

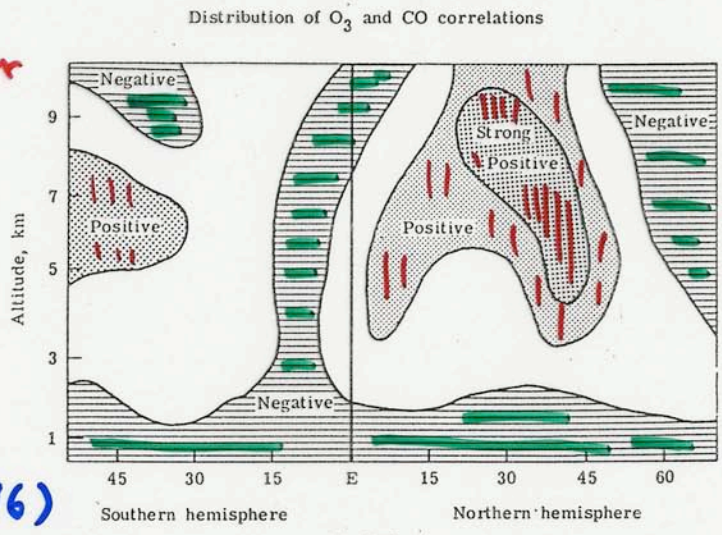


Tropospheric O3-CO Correlation

- What does AIRS show in the tropospheric O3-CO correlation?
- Is the correlation consistent with known geophysical feature/process?

CO as a Tropospheric Tracer : Some Early Work

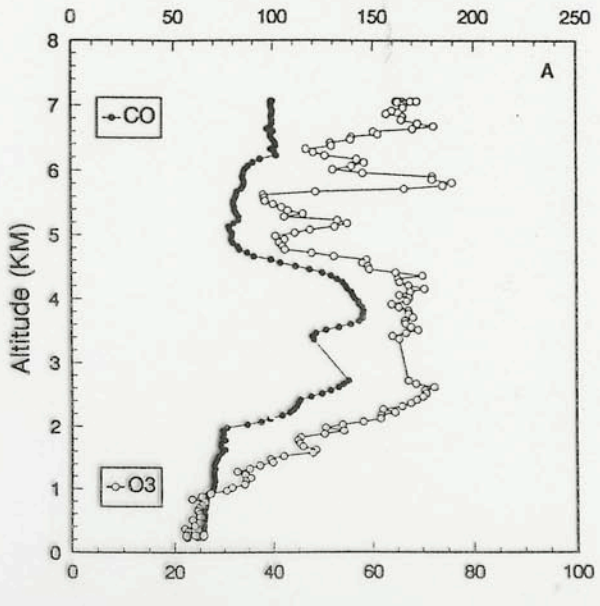
Fishman & Seiler (1983) →



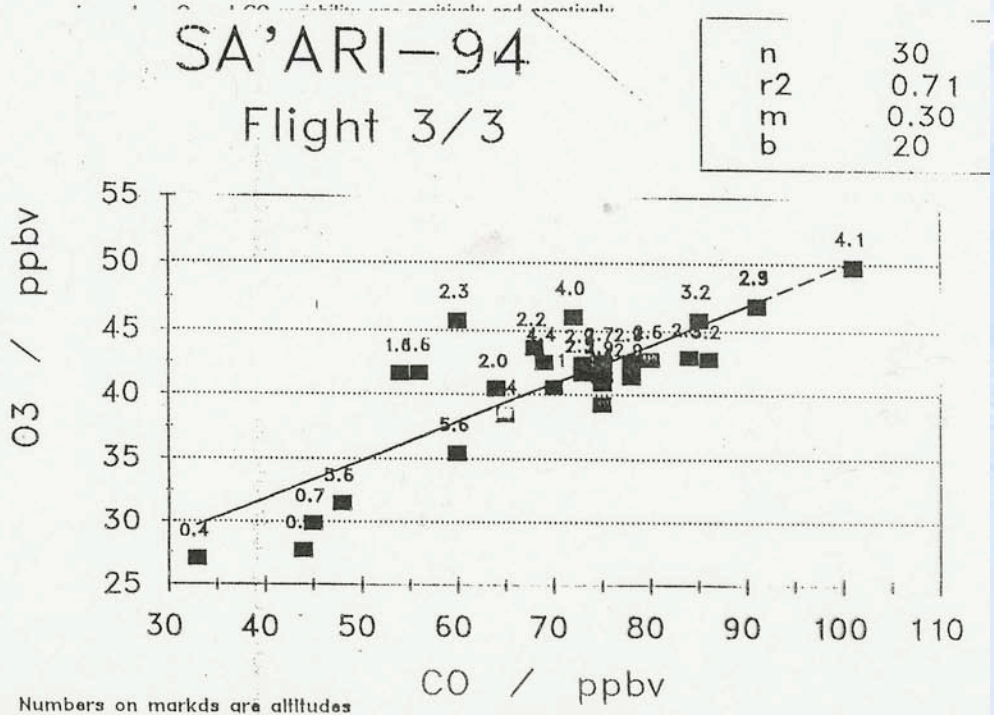
Collins et al (1996)

↓

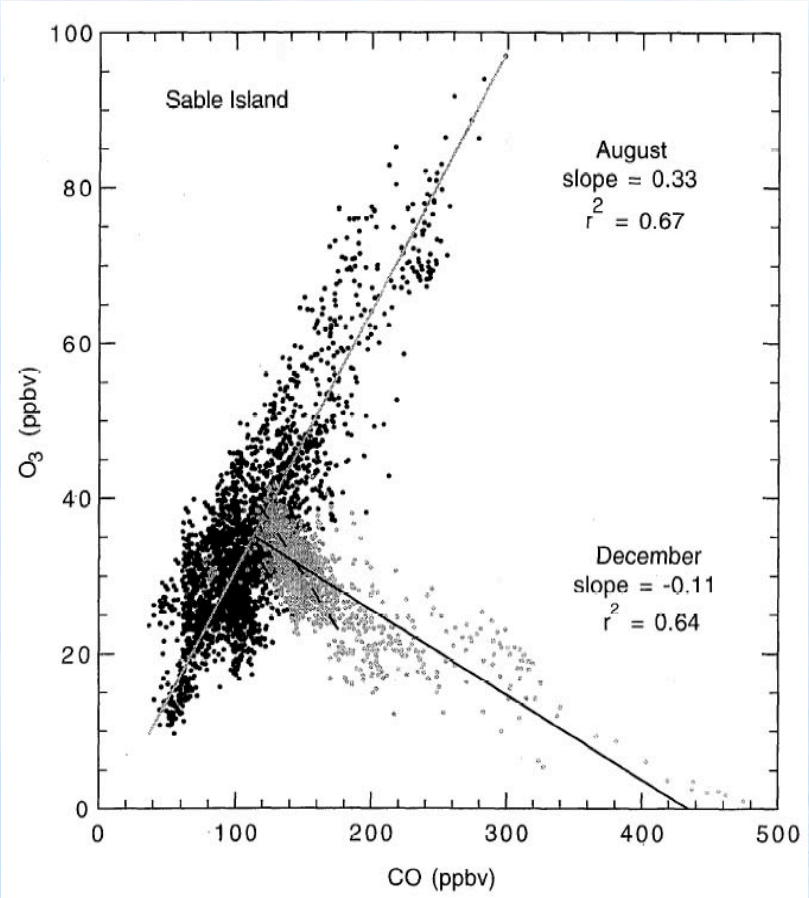
TRACE A Flight 14 - Profile 6 Outflow from Africa
displaying O3-CO relationship



Helas (1994)



O_3-CO correlation: Indicator of ozone production



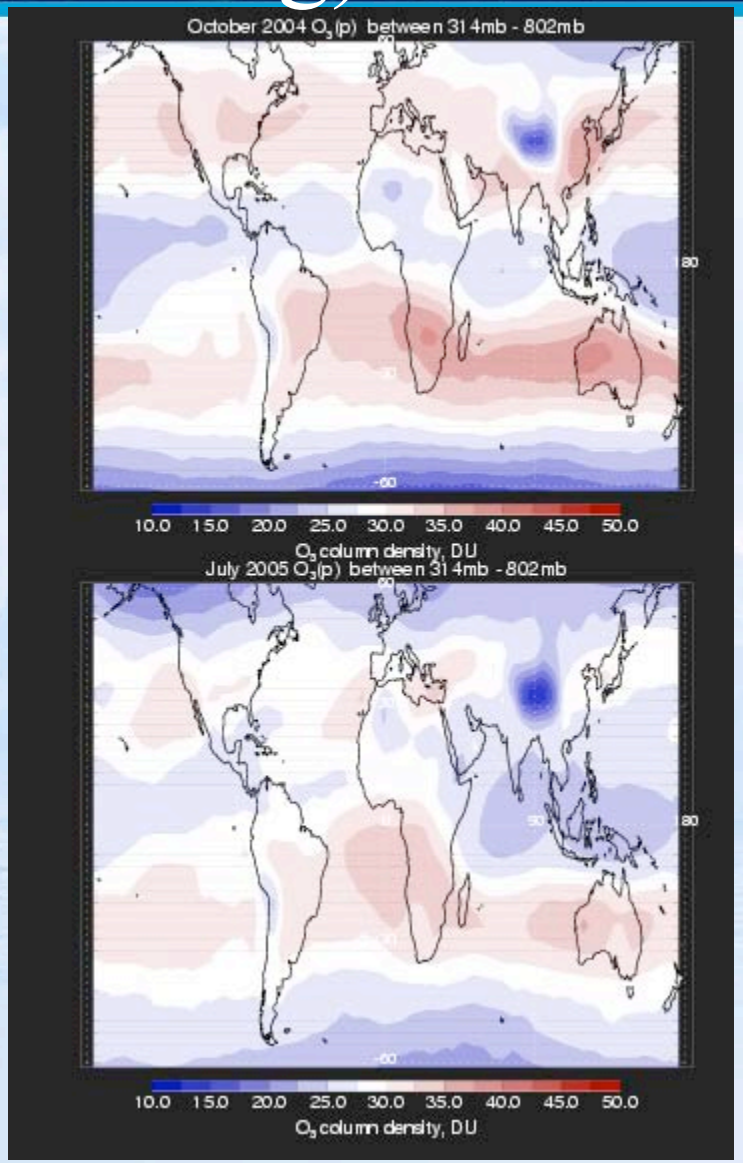
Parrish et al., JGR1998

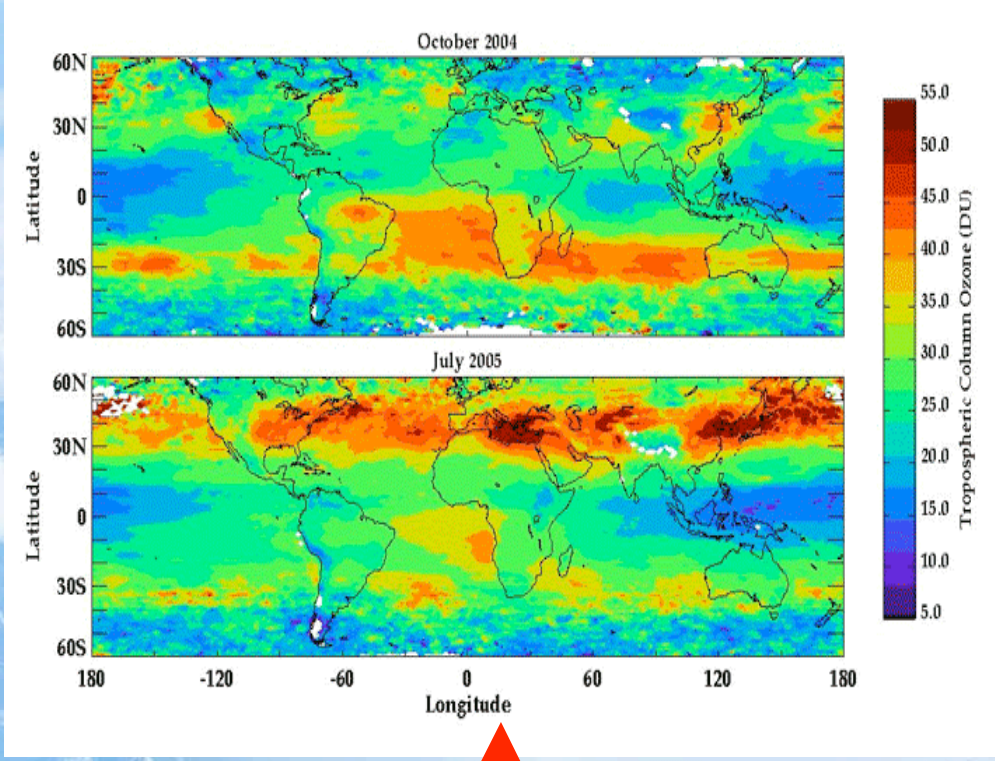
O_3-CO correlations in surface and aircraft data have been used to test understanding of ozone production but the data are sparse.

Mid-Tropospheric Ozone (Biomass Burning)

Ozone

AIRS →

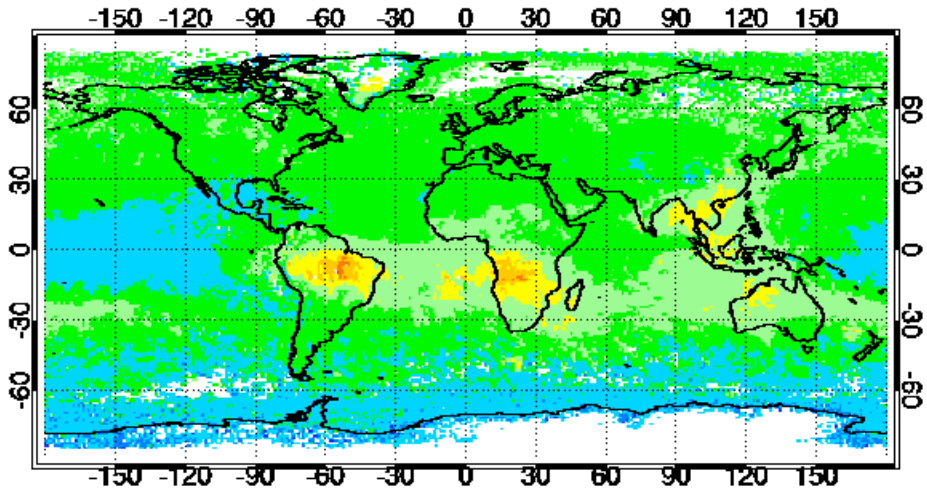


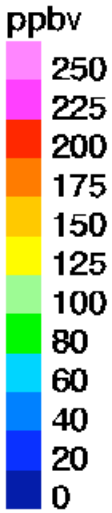


TES

http://aura.gsfc.nasa.gov/science/auratop10.html

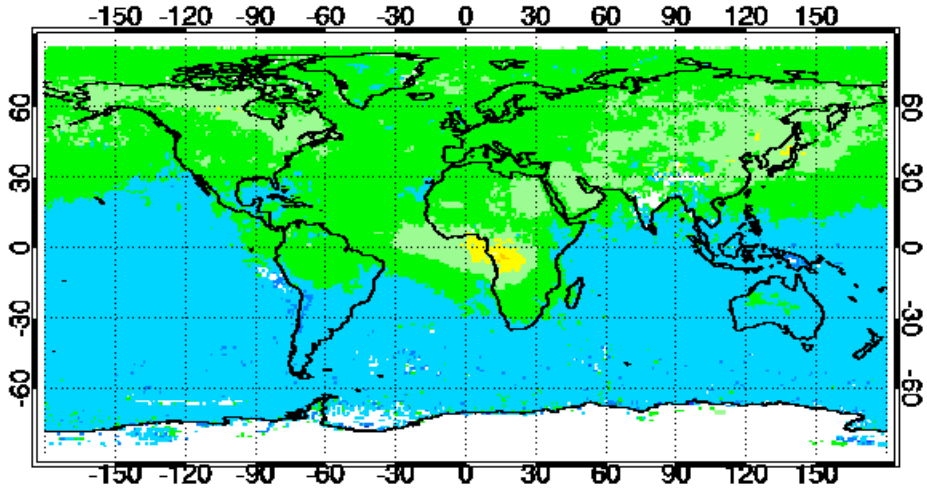
MOPITT CO (V3) 500hPa Oct 1-30, 2004



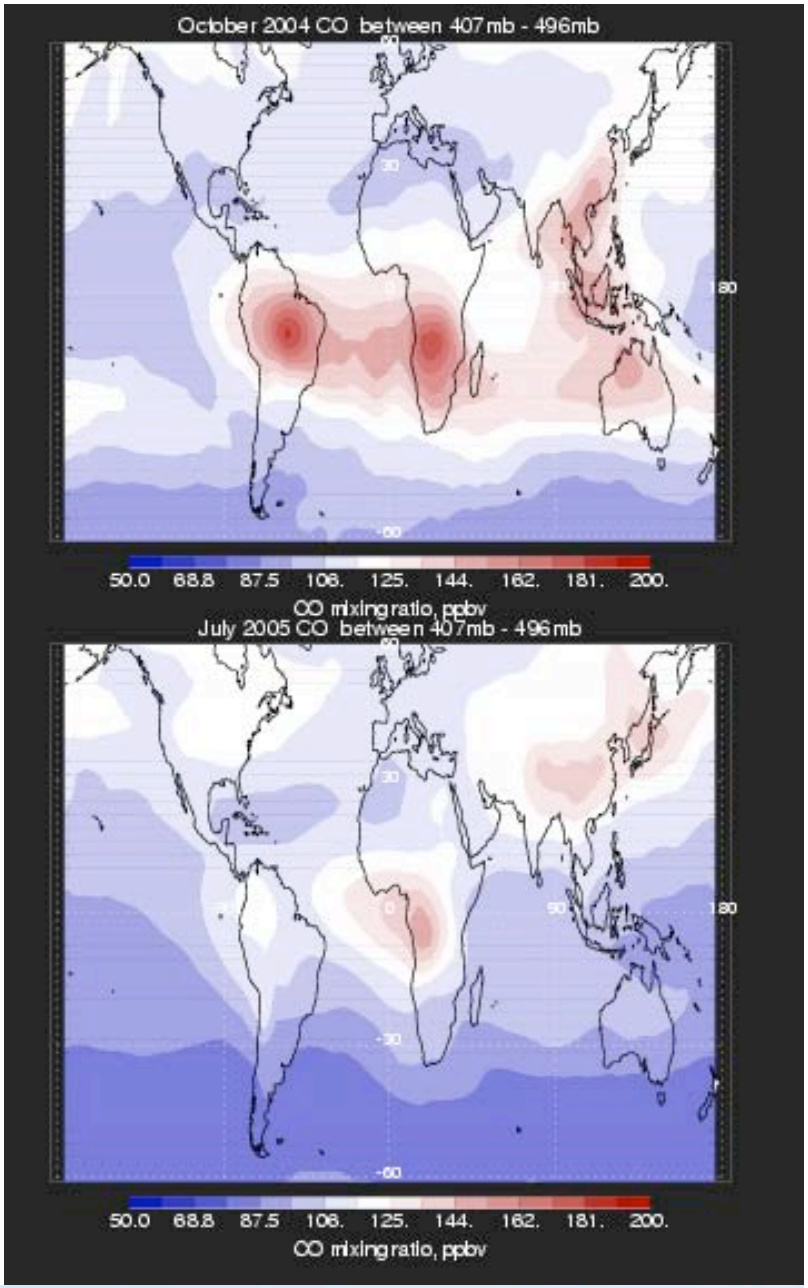


Gridded at 1x1deg from MOP02-200410??-L2V5.*.hdf (apriori fraction < 50%)

MOPITT CO (V3) 500hPa Jul 1-31, 2005



Gridded at 1x1deg from MOP02-200507??-L2V5.*.hdf (apriori fraction < 50%)

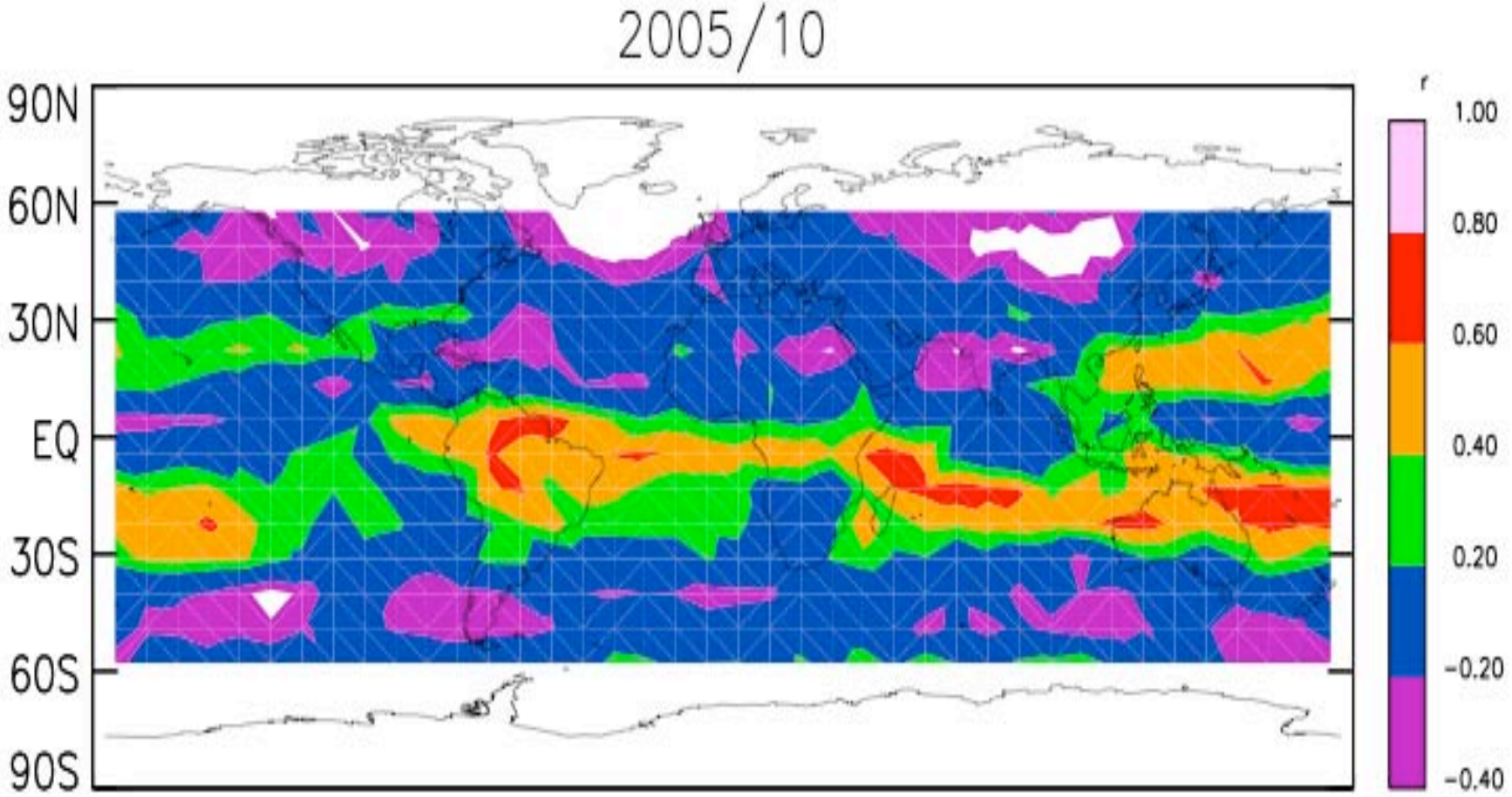


MOPITT

AIRS

http://www.eos.ucar.edu/mopitt/data/plots/mapsv3_mon.html

First Look



Summary

- AIRS Ozone channel sensitivity varies with atmospheric thermal structure

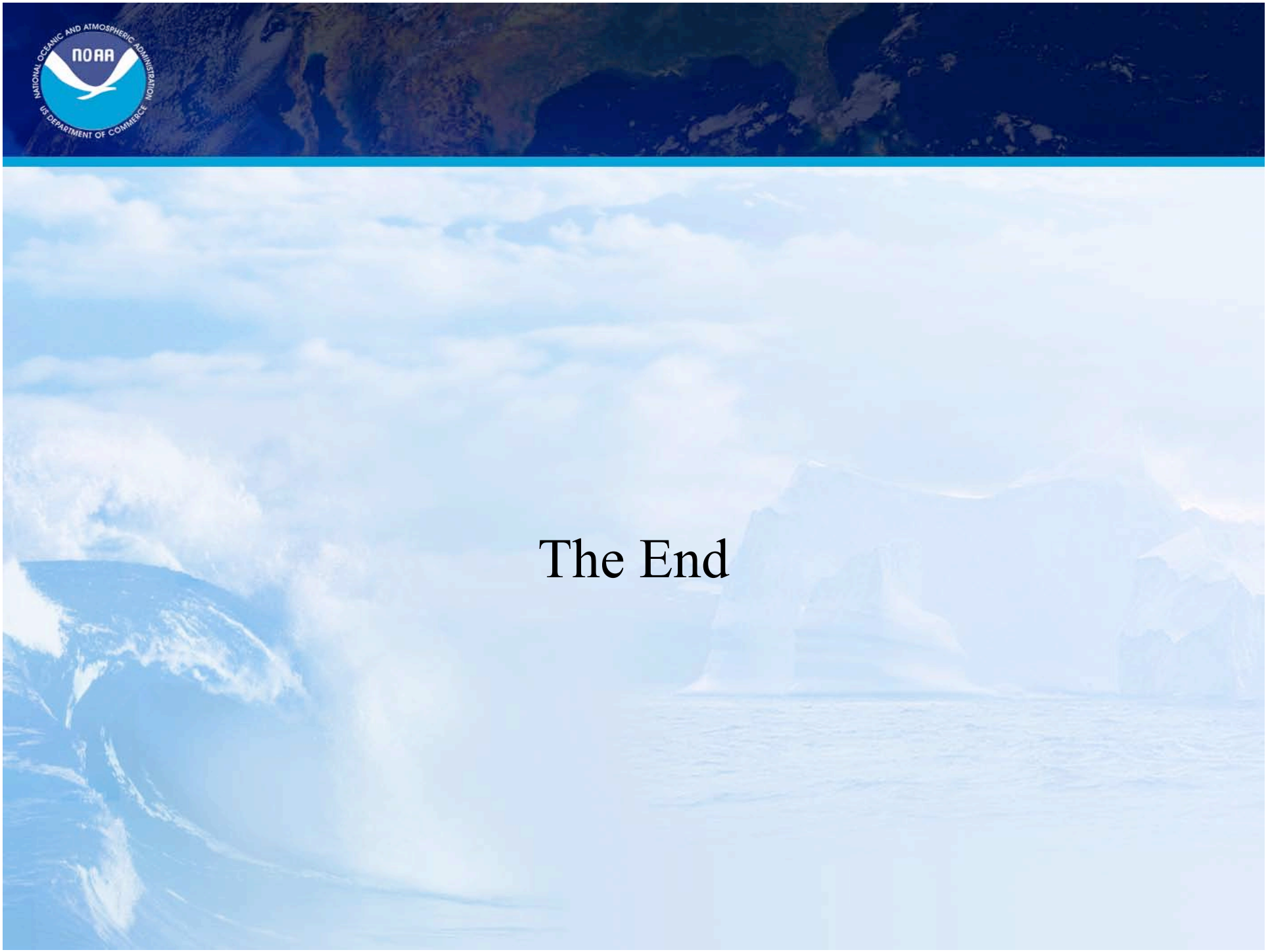
  - case study shows that there is an enhanced tropospheric sensitivity in case of tropopause fold/instrusion.
- AIRS tropospheric tracer correlation (O3-CO) shows consistency with geophysical feature

Summary

Scales	In Situ	Feature	AIRS Skill
Global	Global Sondes (WOUDC) (Beijing) (Lauder)	Global Profile Match-up	• Small bias in stratosphere, larger bias in troposphere • NH is less bias than SH • Agrees well near tropopause • Poor in tropics, due to bad climatology
Large (UT/LS)	START	Stratospheric Intrusion	• Skill, if strong O3 or T(p) gradient layer • Tropospheric variability comes from regression •Too much damping in the physical process
Regional (mid-trop)	AMMA-AEROSE	Biomass Burning	• Qualitatively agree well with TES • ?
Small (boundary)	WAVES	Air Quality	?

Future Plan

- Case study with AMMA-AEROSE and WAVES
- V6 consideration
  - Decide if we need the regression
  - Improve climatology
  - Channel selection, vertical functions, average kernels, etc.


The End